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GUIDES FOR SHORT-TERM EXPOSURES OF THE
PUBLIC TO AIR POLLUTANTS

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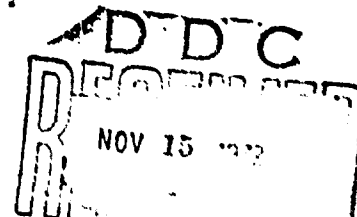
13. ABSTRACT

This report was presented at the Proceedings of the 2nd Annual Conference on Environmental Toxicology, sponsored by the Systemed Corporation and held in Fairborn, Ohio on 31 August, 1 and 2 September 1971. Major technical areas discussed included toxicological evaluation of volatile halogenated compounds, protection of the public against air pollution and toxicological problems with aircraft, missiles, and space vehicles.

Key words:

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GUIDES FOR SHORT-TERM EXPOSURES OF THE PUBLIC
TO AIR POLLUTANTS*

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National Academy of Sciences
Washington, D. C.

The National Academy of Sciences-National Research Council commitment to the Environmental Protection Agency in the area of atmospheric pollutants takes several forms. One form is expressed through the Medical Sciences Division of the Academy-Research Council where a Committee on the Biologic Effects of Air Pollutants does a comprehensive study of a chemical family such as fluoride, lead, nickel, chromium, asbestos, or polycyclic organic matter. These documents, originally conceived as the basis for EPA criteria documents, now serve as scientific reviews of the state-of-knowledge about the chemicals and their compounds. EPA may use the documents in formulating legislative standards but they will not be issued by EPA as criteria documents. Since this administrative change, it has been decided that the Academy should publish the documents in order to make the data available to the scientific community.

Concurrent with the EPA-Medical Sciences Division activity, the Advisory Center on Toxicology has been asked by EPA to provide guidance for short-term exposure of the public to air pollutants. The rationale of this effort lies in the fact that there are both planned and unplanned (accidental) releases of pollutants to the atmosphere to which the public may be exposed. We have come to define the levels applicable to these two situations as Short Term Public Limits (STPL) and Public Emergency Limits (PEL), respectively.

The STPL are designed to recognize a planned, relatively brief, emission of a pollutant to the atmosphere. The public should be able to tolerate relatively high levels of a pollutant if the duration is sufficiently brief and if the frequency of

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exposure and nature of the pollutant are such that no additive or sensitizing effect results. In keeping with previous philosophy on short-term limits, which are based on response time of instrumentation and atmospheric mixing, 10 minutes is considered the shortest time period for which a limit can reasonably be assigned. Other critical time periods for which levels have been set are 30 minutes, 1 hour, and 5 hours per day, 3 to 4 days a month.

PEL's apply to the unplanned or accidental releases of pollutants to the atmosphere. The levels recommended are believed by the Committee to be realistic so as to apply to a true emergency situation yet not so high that any irreversible or residual injury would accrue to the most probable sensitive segment of the exposed population, that is those with respiratory problems such as asthmatics and bronchitics.

We have made available to the EPA the Committee's recommendation for short-term exposures of the public to NO_x , HCl , and HF . The development of each guide has followed the same pattern. The initial task of determining the pertinent literature has been the responsibility of the professional staff of the Advisory Center on Toxicology. The literature is reviewed, evaluated, and used as a basis for the development of a draft guide. The draft guide is submitted to a specially constituted subcommittee of the Committee on Toxicology whose membership includes scientists who have performed toxicological research with the chemical. (The NO_x document was a product of the Committee on Toxicology.) This subcommittee then assumes responsibility for the document which in turn is submitted to the Committee on Toxicology for approval. Outside reviewers also comment on the document before it is released to EPA.

This rather lengthy and detailed technical-administrative process attending the development of a short-term guide may seem to some as overdoing it a bit, yet in the final analysis there may be those who feel it might not be enough. There seems never to be the right kind of data that will allow a direct extrapolation to a contamination level known to be safe for the more sensitive segments of the population. Thus in each of the three guides that have been written, NO_x , HCl , HF , the committees have found it necessary to urge additional research to lend greater support to the levels they have recommended or to provide data on which to base a modification of the limits.

Oxides of Nitrogen

In terms of air pollution, three oxides of nitrogen are of significance: NO , NO_2 , N_2O_5 . NO is of minimal concern since it is not an irritant gas and is only about one-fifth as acutely toxic as NO_2 , to which it is eventually converted in the presence of oxygen. N_2O_5 , if it exists in significant quantities in the atmosphere at all, does so only briefly. It is generally agreed that the ultimate fate of N_2O_5 is conversion to NO_2 . It has been calculated that in 1968 the total nationwide emission

of nitrogen oxides was about 20.6×10^6 tons, with all forms of transportation contributing approximately 40%, and stationary fuel combustion sources approximately 50% (Lagarias and Herrick, 1971).

NO_2 as a freely diffusible gas has the capability of causing adverse health effects as a deep lung irritant at high concentrations - several hundred ppm for a few minutes - that might lead to pulmonary edema. Many variations in toxicity patterns occur with NO_2 : toxicity is enhanced in the presence of O_3 , SO_2 , aldehydes, and a high density of respirable particles. The ambient temperature and the age of the exposed person also markedly influence individual response. The Committee on Toxicology, having evaluated all of the influences on NO_2 toxicity, recommended the following short-term limits:

STPL

10 min.	1 ppm
30 min.	1 ppm
60 min.	1 ppm
5 hrs. /day, 3-4 days/mo.	

PEL

10 min.	5 ppm
30 min.	3 ppm
60 min.	2 ppm

Hydrogen Chloride

SUBCOMMITTEE ON HYDROGEN CHLORIDE

V. K. Rowe, Chairman
Kenneth C. Back
David W. Fassett

The major sources of atmospheric HCl are HCl synthesis plants, plastics manufacturing, and incineration, but more than half is related to the use of HCl in the synthesis of other organic chemicals. Anhydrous HCl may cause more severe injury to tissues than the hydrated form because of its dehydrating action. Except in unusually dry atmospheres, HCl would react quickly with moisture in the air to form an aqueous acid aerosol. Both the gas and the acid aerosol act as contact irritants with the epithelium and mucous membranes of the respiratory tract and conjunctivae of the eyes as the more sensitive sites of action due to absorption.

Several studies have been done on odor thresholds with results ranging from less than 1 ppm to about 5 ppm. Inhalation of 1000 ppm for one hour is dangerous to life and levels as low as 50 to 100 ppm have been shown to interfere with work.

Depending on the severity of exposure, the physiological responses to the inhalation of irritating levels of HCl are coughing, pain, inflammation, edema, and desquamation in the upper respiratory tract. If concentrations are high enough, acute irritation may bring about constriction of the larynx and bronchi, closure of the glottis, and breath holding. Fatal inhalation of HCl would be expected only when the victim is unable to escape from the contaminated atmosphere.

The Committee believes that the following levels which they recommended do not present any health hazard although the odor might be detectable and minimal irritation could occur:

STPL

10 min.	4 ppm
30 and 60 min.	2 ppm
5 hrs. /day, 3-4 days/mo.	0.67 ppm

PEL

10 min.	6.7 ppm
30 and 60 min.	3.4 ppm

Hydrogen Fluoride

SUBCOMMITTEE ON HYDROGEN FLUORIDE

Arthur B. DuBois, Chairman
 Moreno L. Keplinger
 Charles F. Reinhardt
 David L. Stoddard

Active volcanoes are the only known natural source of HF. It is a major constituent of effluents from fumaroles. It is this source that contributes background levels that have been detected in remote areas. Other sources include aluminum reduction plants, phosphate fertilizer plants, petroleum refineries, fluorocarbon manufacturing, welding, burning of coal, and ignition of rocket propellants.

Gaseous HF rarely exists in monomolecular form; rather, it tends to associate in molecules up to H_6F_6 . This association may lead to some equivocation in experimental results since the investigator may not in fact know whether he is measuring

the effects of HF, or H_2F_8 , or an association somewhere in between. The relative toxicities of the different associations are known to be different, but precision is lacking.

HF, like HCl, readily combines with moisture in the atmosphere to form an almost colorless fog, which in effect is an aqueous acid aerosol. In this form, it is corrosive to almost all forms of organic and inorganic materials.

The primary effect of acute exposure to gaseous HF in concentrations above a few ppm is irritation to the skin, eyes, and respiratory passages. Localized tissue damage may result on exposure to concentrations above recommended limits. At 12 ppm the mucosa are irritated, at 30 ppm for about 3 minutes the gas is detectable by taste, at 60 ppm the severity of irritation is noticeably increased, and at 120 ppm a stinging sensation of the skin is added, and the other irritations become so intense that man is unable to withstand the exposure for more than one minute.

Fluorides are also injurious to plants through systemic absorption of the gas and the accumulation of fluorides on the leaves. Plants show a wide range of tolerance to fluorides; some plants, gladiolus for example, suffer major damage when tissue accumulation reaches 20 ppm from atmospheric levels as low as a few $\mu g/M^3$. Yet other plants, camelia for example, can tolerate tissue accumulation to 1500 ppm.

Fluorides also cause an illness of cattle called fluorosis, resulting from the ingestion of contaminated grasses and forage in areas near sources of HF effluents. Inhaled HF plays an insignificant role in fluorosis because of dilution.

The Committee, recognizing the extreme hazard to health of HF, leaned conservatively in making the following recommendations:

STPL

10, 30, and 60 min.	4 ppm
5 hrs. /day, 3-4 days/mo.	1 ppm

PEL

10 min.	10 ppm
30 and 60 min.	5 ppm

REFERENCES

1. Lagarias, J. S., and R. A. Herrick; "Impact of Energy Consumption on the Environment"; A. J. P. H., 61, July 1971.